

New LCA Theses

Environmental Systems Analysis of Pig Production

Development and application of tools for evaluation of the environmental impact of feed choice

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The aim of this thesis was to develop the SALSA models (Systems AnaLysis for Sustainable Agriculture), and to apply them to studies for the benefit of more sustainable pig production.

Within the framework of environmental systems analysis, the SALSA models were constructed as substance and energy flow models using life cycle assessment methodology for impact assessment and scope definition. The pig production system studied included rearing of growing-finishing pigs (SALSA-pig model) and production of feed (SALSA-arable and SALSA-soybean models).

For energy use, global warming potential and eutrophication, the feed production sub-system had the largest environmental impact, whereas for acidification the pig sub-system was the dominant source.

Results from simulations using the SALSA-arable model showed that energy use, global warming potential and acidification increased with increasing nitrogen fertiliser rate, whereas eutrophication had a minimum around the current recommended rate.

When the pig production system was optimised regarding diet composition for different environmental targets, different diets were obtained. For acidification and eutrophication, a low protein diet was prioritised, which was achieved by high inclusion of synthetic amino acids. For energy use and global warming potential high levels of peas and rapeseed cake (a by-product from rapeseed oil production) were prioritised. The environmental optimiser almost entirely avoided soybean meal, due to its poor environmental record.

A main conclusion of the work was that feed choice had an impact on the environmental performance of pig meat production, not only via the features of the feed as fed to the pigs, such

as the crude protein content, but also via the raw materials used, since the environmental impact from the production of these differed and since feed production generally had a large impact on the system as a whole.

Keywords: Feed production; growing-finishing pigs; optimisation model; pig production; SALSA models (Systems AnaLysis for Sustainable Agriculture); soybean meal

List of Papers

This thesis is based on the following papers, appended and referred to in the text by their Roman numerals. Paper III is reproduced with kind permission of the publisher.

I. Elmquist H, Strid Eriksson I, Öborn I, Nybrant T (2004): Environmental systems analysis of winter wheat, spring barley and spring rapeseed – A study on effects of nitrogen fertiliser application rates using a simulation model. (Manuscript)

II. Strid Eriksson I, Nybrant T (2004): SALSA-pig – A simulation tool for environmental systems analysis of pig rearing. (Manuscript)

III. Strid Eriksson I, Elmquist H, Stern S, Nybrant T (2004): Environmental Systems Analysis of Pig Production: The impact of feed choice. *Int J LCA* 10 (2) 143–154 <DOI: <http://dx.doi.org/10.1065/lca2004.06.160>>

IV. Strid Eriksson I, Stern S, Nybrant T (2004): Optimisation of pig diets with respect to energy use, global warming, acidification and eutrophication. (Submitted to *Agricultural Systems*)

Notes on the authorship of the included papers:

In Paper I, Strid Eriksson developed parts of the SALSA-arable model (field operations, grain drying, nitrous oxide emissions and the impact assessment) and wrote parts of the text.

In Papers II–IV, the studies were to a very large extent planned, carried out and described by Strid Eriksson. The results were based on three models, of which Strid Eriksson developed the SALSA-pig and SALSA-soybean models and parts of the SALSA-arable model.

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